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Attorney Docket Number: PCT$ 11413

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09/601083 PATENTS

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jc841 U.S. PTO
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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

International Application Number: PCT/SE99/00095

International Filing Date: 01/25/1999

Priority Date Claimed: 01/26/1998

Title of Invention: CATALYTIC GAS TREATMENT DEVICE

Applicant(s) for DO/EO/US: HEED, Björn

Applicant herewith submits to the Unites States Designed/Elected Office (DO/EO/US) the following items under 35 U.S.C. 371:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to immediately begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the international Application as filed (35 U.S.C. 371(c)(2)):
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English
7. ☐ Amendments to the claims of the International Application under PCT Article 19:
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has **NOT** expired.
   d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19(35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)):
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ will follow.
10. ☐ A translation of the Annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
11. ☒ Copy of the:
   a. ☒ International Preliminary Examination Report.
   b. ☒ International Search Report.
12. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
13. ☐ An Assignment document for recording with a separate cover sheet in compliance with 37 CFR 3.28 and 3.31:
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ will follow.
14. ☒ A **FIRST** preliminary amendment.
15. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☐ Verified Small Entity Declaration
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ will follow.
19. ☐ Other items of information: .....

20. ☒ 1 Sheets of drawings are enclosed.

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21. ☒ The U.S. National Fee (35 U.S.C. 371(c)(1)) and other fees as follows: 534 Rec'd PCT/PTC 25 JUL 2000

NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):	*TOTAL*
☐ Search Report has been prepared by the EPO or JPO	$0
☐ International Preliminary Examination fee paid to USPTO (37 CFR 1.482)	$0
☐ No International Preliminary examination fee paid to USPTO (37 CFR 1.482) but international dearch fee paid to USPTO (37 CFR 1.445(a)(2))	$0
☑ Neither International Preliminary examination fee (37 CFR 1.482) nor International Search fee (37 CFR 1.445(a)(2)) paid to USPTO	$970
☐ International Preliminary Examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)	$0
☐ Surcharge for furnishing the oath of declaration later than **20** months from the earliest claimed priority date (37 CFR 1.492(e))	$0
☐ Surcharge for furnishing the oath of declaration later than **30** months from the earliest claimed priority date (37 CFR 1.492(e))	$0
☐ Processing fee for furnishing the English translation later than the **20** months from the earliest claimed priority date (37 CFR 1.492(f))	$0
☐ Processing fee for furnishing the English translation later than the **30** months from the earliest claimed priority date (37 CFR 1.492(f))	$0
☐ Assignment Recordal Sheet	$0

	Number of Claims Filed	Number of Claims Allowed	Number of Extra Claims	Rate per Extra Claim	
Number of Dependent Claims Filed	20	20	0	$18	$0
Number of Independent Claims Filed	1	3	0	$78	$0

	Yes	No	Rate per Application	
Number of Multiple Dependent Claims Filed		X	$260	$0

Total Fees Enclosed for Large Entity	$970
Total Fees Enclosed for Small Entity (1/2 of Large Entity)	$485

a. ☒ A check in the amount of $ 970 to cover the fee is enclosed.
b. ☐ Please charge my deposit account $ 0 to cover the above fees. A duplicate copy of this sheet is enclosed.
c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, including request for extension and payment of extension fees due, when this is not explicitly requested by applicants, with a view toward avoidance of abandonment, to Deposit account No. 04-2219, referencing our docket # **11413** . Any overpayment should be credited to this account.

Please direct all communication in connection with this application to the undersigned at:

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CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this transmittal letter and the documents referred to as enclosed therein are being deposited with the United States Postal Service on , in an envelope as "Express Mail Post Office Addressee", mailing label number addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Sharon Stolfa
Name of Person Mailing Paper

Signature of Person Mailing Paper

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of)
)
Applicant: **HEED, Björn**)
)
Serial No.: To be assigned)
)
PCT Application No.: PCT/SE99/00095)
)
Filed: January 25, 1999)

For: CATALYTIC GAS TREATMENT DEVICE

Attorney Docket No. 11413

PRELIMINARY AMENDMENT

Hon. Commissioner of
Patents and Trademarks
Washington, D.C. 20231

July 25, 2000

Sir:

Please amend the newly submitted patent application described above as follows:

In the Claims:

Please amend the claims as follows:

Claim 8, line 2, delete "claims 1-6" and insert --claim 1--.

Claim 9, line 2, delete "claim 1-6" and insert --claim 1--.

Claim 10, line 2, delete "claims 1-6" and insert --claim 1--.

Claim 11, line 2, delete "claim 1-9" and insert --claim 1--.

Please add the following claims:

12. A device for catalytic treatment of gas as claimed in claim 2, characterized in that the band is coated with a catalyst on the inlet side of the band and possibly also on the outlet side of the band.

13. A device for catalytic treatment of gas as claimed in claim 2, characterized in that

the band is coated with a catalyst only on the outlet side of the band.

14. A device for catalytic treatment of gas as claimed in claim 2, characterized in that the two sides of the band are coated with a different kind of catalyst.

15. A device for catalytic treatment of gas as claimed in claim 2, characterized in that the band is coated with a catalyst only on the band parts closest to the gas reversal chambers (4,5).

16. A device for catalytic treatment of gas as claimed in claim 3, characterized in that the band is coated with a catalyst on the inlet side of the band and possibly also on the outlet side of the band.

17. A device for catalytic treatment of gas as claimed in claim 3, characterized in that the band is coated with a catalyst only on the outlet side of the band.

18. A device for catalytic treatment of gas as claimed in claim 3, characterized in that the two sides of the band are coated with a different kind of catalyst.

19. A device for catalytic treatment of gas as claimed in claim 3, characterized in that the band is coated with a catalyst only on the band parts closest to the gas reversal chambers (4,5).

20. A device for catalytic treatment of gas as claimed in claim 4, characterized in that the band is coated with a catalyst only on the band parts closest to the gas reversal chambers (4,5).

REMARKS:

The foregoing amendments are primarily for the purpose of eliminating multiple dependencies, and placing the claims in proper form.

Respectfully submitted,

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WO 99/37897

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CATALYTIC GAS TREATMENT DEVICE

The present invention relates to a catalytic gas-mixture treatment device of the kind defined in the preamble of the appended claim 1.

The Swedish Patent No. 503 172 describes a catalytic device comprising a catalyst-coated, patterned band, which is folded into a package for the purpose of simultaneously achieving heat exchange and catalytic treatment of a flow of gas. In the process, the flow may be divided into several parallel part flows, which are again united into one single flow. This is effected by blowing the gas flow into and withdrawing it from the package at opposite package sides at one of the package ends. There is no need for a separate gas-distributing device of manifold type and as long as the temperature is moderate, there is no difficulty in sealing the band-package end against the end wall of the enclosure or casing. Such sealing is necessary to prevent untreated gas from leaking past the heat exchange-catalyst unit.

When the temperature of the entering gas is high, which sometimes is the case in the treatment of motor vehicle exhaust gases, it may be difficult to achieve efficient sealing of this kind. Conventional sealing materials or sealing compounds of rubber or plastics cannot withstand the high temperatures involved. A sheet of ceramic fibrous felt may be used as the seal along the sides of the band package, where considerable surfaces of contact exist. On the other hand, at the end walls, the seal is to be applied against the thin edges of the band, which makes efficient sealing much more difficult to achieve.

In accordance with the present invention a solution to this sealing problem has been found in that the channels in the package alternately are connected to inlets or outlets located at the sides of the package and to gas

reversal chambers located one at both ends of the package, whereby as the gas flows through the device, heat will be exchanged between the incoming and exiting flows as the flow direction changes from a direction of entry at an angle to the band folds to mutually opposite directions along one side of the band in the package, and from there, following reversal externally of the package ends in the respective gas reversal chamber, to the opposite side of the band in the pack while flowing in the opposite direction along the edges of the band folds, and from there towards a direction of exit at an angle to said edges.

One embodiment of the invention is illustrated in the accompanying drawing figure. For the sake of clarity, the drawing figure illustrates the inventive object in an unassembled condition and without the top of the casing 2. A package 1 of a patterned and folded band is received inside a casing 2. Gas enters through an inlet port 3, in the example shown centrally on one side of the band package. The gas flow divides into two oppositely directed part flows, each flowing towards its respective package end and the gas reversal chambers 4 and 5 located there. In the gas reversal chambers the gas may be heated by the heating elements 7 and 8, respectively, alternatively by hot gas or hot air supplied to the gas reversal chambers, and from these chambers the gas reverses, flowing along the opposite side of the band, towards the centre of the band package and exits through the outlet port 6.

As the gas passes through the device, recuperative exchange of heat takes place via the band material between gas on its way to and gas on its way from, respectively, the gas reversal chambers. The band constituting the band package consequently serves both as a heat-exchange partition wall between the incoming and exiting flows and as a catalyst carrier. In this manner, the heat-exchange process is made independent of the temperature of the incoming gas and the catalytic

treatment may be carried out at an high temperature without considerable amounts of energy having to be supplied in the gas reversal chambers.

Owing to the division of the incoming flow into two part flows, one to each gas reversal chamber 4, 5, sealing against the end walls is not necessary. The only seals needed are the seal positioned between the bottom face of the package 1 and the casing bottom (not shown in the drawing figure) and the seal 7 required between the upper face of the package 1 and the casing top, not included in the drawing figure. Owing to the considerable surface of contact, these seals may both consist of ceramic fibrous felt. No sealing is required at the two package ends and the gas reversal chambers 4, 5. This feature makes the inventive device highly suitable for treatment of gas entering the device at a high temperature. In some cases, for example to prevent damage to the catalyst coating, it may be necessary to cool the gas in the gas reversal chambers rather than heating it. Advantageously, cooling is effected by supply of cool air or gas to the gas reversal chambers 4, 5 or, alternatively, by means of refrigerating coils or refrigerating elements located therein. As a result of the heat exchange taking place between the gas flowing towards the gas reversal chambers and the gas mixture flowing towards the outlet port, the major part of the band package will have a lower temperature than the incoming gas.

A further advantage of the invention is that for a given width and height of the band package the pressure drop of the gas passing through the device is smaller than it would have been, had the entire gas flow been forced to pass through a package in one direction only.

In the manner described in the Swedish Patent No 503 172 it may be advantageous, depending on the prevailing circumstances, to coat both band sides or only one side thereof with a catalyst. As described in that publication, it may also in some instances be advan-

tageous to coat the two band sides with a different catalyst. Furthermore, as also described therein, it may sometimes be advantageous to coat only the parts of the band closest to the gas reversal chambers with a catalyst.

The design and arrangement of the temperature-modifying and temperature-controlling devices, such as heating and/or refrigerating devices, that are located in the gas reversal chambers, may be altered in many different ways without departure from the inventive idea. Also, the devices in the two chambers may be of a mutually different nature.

CLAIMS

1. A device for catalytic treatment of gas mixtures, wherein:

a) the catalyst is spread on a carrier, which also forms a partition wall in a recuperative heat exchanger,

b) the partition wall consists of a shaped patterned band of metal or ceramic, which is folded in an accordion-like manner into a package (1), and

c) the package forms alternately disposed channels with exchange of heat taking place between the channels through the band material, the geometry of the channels being determined by the folding and the shaped pattern of the band, c h a r a c t e r i s e d in that the alternately disposed channels in the package (1) are connected to inlets or outlets (3, 6) located at the sides of the package (1) and to gas reversal chambers (4, 5) located one at both ends of the package, whereby as the gas flows through the device, heat will be exchanged between the incoming and exiting flows as the flow direction changes from a direction of entry at an angle to the band folds to mutually opposite directions along one side of the band in the package, and from there, following reversal externally of the package ends in the respective gas reversal chamber, to the opposite side of the band in the pack while flowing in the opposite direction along the edges of the band folds, and from there towards a direction of exit at an angle to said edges.

2. A device for catalytic treatment of gas as claimed in claim 1, c h a r a c t e r i s e d in that at least one of the gas reversal chambers (4, 5) houses devices controlling and affecting the temperature of the gas flowing past said chambers, said devices preferably being heating devices (7, 8).

3. A device for catalytic treatment of gas as claimed in claim 2, c h a r a c t e r i s e d in that at

least in one of the gas reversal chambers said heating device is an electric heater.

4. A device for catalytic treatment of gas as claimed in claim 2, c h a r a c t e r i s e d in that it comprises heating devices including burners using gas or liquid fuel.

5. A device for catalytic treatment of gas as claimed in claim 1, c h a r a c t e r i s e d in that it is adapted for heating at least one of the gas reversal chambers (4, 5) by means of supply of hot gas.

6. A device for catalytic treatment of gas as claimed in claim 1, c h a r a c t e r i s e d in that it is adapted for cooling at least one of the gas reversal chambers (4, 5) by means of supply of cool gas.

7. A device for catalytic treatment of gas as claimed in claim 1, c h a r a c t e r i s e d in that it comprises refrigerating elements disposed in the gas reversal chamber in question.

8. A device for catalytic treatment of gas as claimed in claims 1 - 6, c h a r a c t e r i s e d in that the band is coated with a catalyst on the inlet side of the band and possibly also on the outlet side of the band.

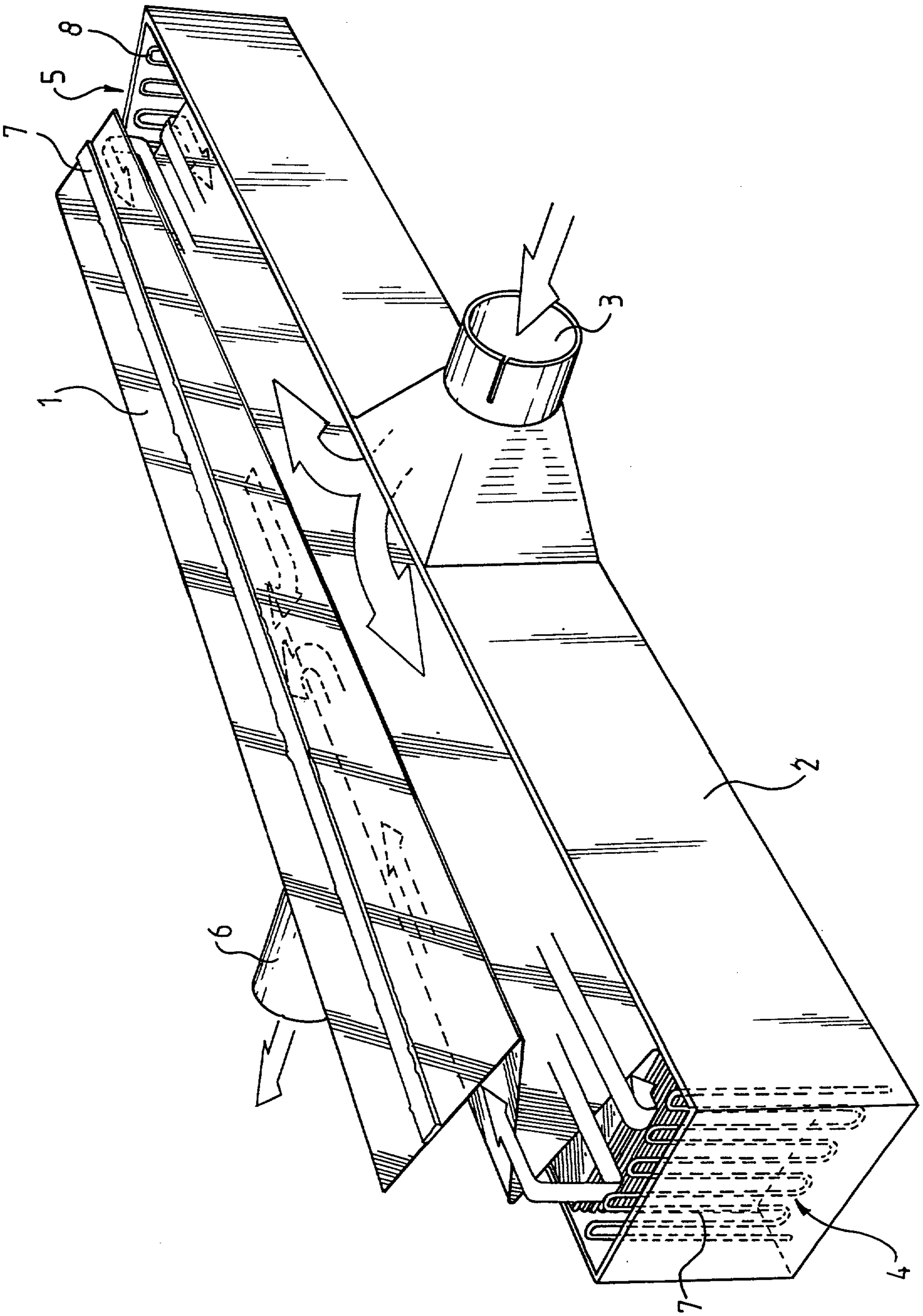
9. A device for catalytic treatment of gas as claimed in claim 1 - 6, c h a r a c t e r i s e d in that the band is coated with a catalyst only on the outlet side of the band.

10. A device for catalytic treatment of gas as claimed in claims 1 - 6, c h a r a c t e r i s e d in that the two sides of the band are coated with a different kind of catalyst.

11. A device for catalytic treatment of gas as claimed in claim 1 - 9, c h a r a c t e r i s e d in that the band is coated with a catalyst only on the band parts closest to the gas reversal chambers (4, 5).

ABSTRACT

A device for catalytic treatment of air or gases. The catalyst is carried on a shaped patterned band. The band is folded into a package, which, when received in a casing, forms two groups of parallel flow channels having a single connection for incoming and exiting flows at the sides of the package, and gas reversal chambers at the package ends. The gas reversal chambers may enclose heating or cooling devices. The exchange of heat between the incoming flow and the exiting flow provides excellent heat economy.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DECLARATION OF INVENTORSHIP AND POWER OF ATTORNEY FOR UNITED STATES PATENT OR DESIGN APPLICATION

FILED IN PATENT OFFICE

Attorney Docket No. C11413

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

CATALYTIC GAS TREATMENT DEVICE

the specification of which

(check one) ☒ is attached hereto.

☐ was previously filed. U.S. serial number not yet available to applicant. A copy of the specification as filed is attached for identification purposes.

☐ was filed on _____ Attorney Docket No. _____

☐ was filed on _____ Under Application Serial No. _____

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information which is material to Patentability as defined in 37 CFR § 1.56.

I hereby claim the benefits under 35 USC § 119(e) of any United States application(s) listed below, or 35 USC § 172 of any foreign application(s) listed below.

Prior US Provisional or Foreign Application(s):

APPLICATION NUMBER	COUNTRY	FILING DATE (Day/Month/Year)
9800197-7	Sweden	26 January 1998

I hereby claim the benefit under 35 USC § 120 of any United States application(s) listed below, and any prior filed International application under 35 USC § 365 listed below, and sofar as the subject matter of each of the claims of this application is not disclosed in the prior application, I acknowledge the duty to disclose to the Office information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the filing date of this application.

APPLICATION NUMBER	FILING DATE (Day/Month/Year)	STATUS (Patented, Pending, Abandoned)
PCT/SE99/00095	25 January 1999	Pending

I hereby appoint the following attorney(s) and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: KEITH H. ORUM (33985), SUSAN M. KEATING (41887), ANDREW D. BABCOCK (44517), GEORGE F. DVORAK (17656).

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I hereby declare that all statements made herin of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willfull false statements and the like so made are punishable by fine or imprisonment, or both, under 18 USC 1001, and that such willful false statements may jeopardize the validity of the application or any patent issuing theron.

Full name of sole or first inventor: HEED, Björn

Inventor's signature: Björn Heed Date: 7 July 2000

Residence (City & Country): Göteborg, Sweden Citizenship: Swedish

Post Office Address: Utlandagatan 19, SE-412 61 Göteborg, Sweden

Full name of sole or second inventor:

Inventor's signature: Date:

Residence (City & Country): Citizenship:

Post Office Address:

Full name of sole or third inventor:

Inventor's signature: Date:

Residence (City & Country): Citizenship:

Post Office Address:

Full name of sole or fourth inventor:

Inventor's signature: Date:

Residence (City & Country): Citizenship:

Post Office Address:

Full name of sole or fifth inventor:

Inventor's signature: Date:

Residence (City & Country): Citizenship:

Post Office Address:

Full name of sole or sixth inventor:

Inventor's signature: Date:

Residence (City & Country): Citizenship:

Post Office Address:

Full name of sole or seventh inventor:

Inventor's signature: Date:

Residence (City & Country): Citizenship:

Post Office Address: